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(54) **SECONDARY BATTERY**

SEKUNDÄRBATTERIE

BATTERIE SECONDAIRE

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Description

BACKGROUND

1. Field

[0001] Exemplary embodiments relate to a secondary battery.

2. Description of the Related Art

[0002] In general, a primary battery is not rechargeable, but a secondary battery can be charged and discharged. Low-capacity secondary batteries are used in portable small-sized electronic devices, such as a smart phone, a feature phone, a notebook computer, a camcorder and the like, and high-capacity secondary batteries are extensively used as an energy source for driving a motor for a hybrid car, an electric vehicle, a power storage cell, and the like.

[0003] The secondary battery includes an electrode assembly including a positive electrode and a negative electrode, a case accommodating the electrode assembly, and an electrode tab connected to the electrode assembly. The case can be classified into a cylindrical type, a prismatic type, a pouch type, and so on according to the external shape of the case. Specifically, the pouch type secondary battery can be easily transformed in various shapes and can be formed of a laminate exterior case having a small weight.

[0004] Following documents are relevant examples relating to pouch type secondary batteries: JP 2002 075299 A and US 2015/118533 A1.

[0005] The above information disclosed in this Background section is only for enhancement of understanding of the background of the described technology and therefore it may contain information that does not form the prior art that is already known in this country to a person of ordinary skill in the art.

SUMMARY

[0006] The present invention is a secondary battery according to independent claim 1. Preferred embodiments are defined in dependent claims 2 to 7. According to the present invention, there is provided a secondary battery including an electrode assembly, and a laminate exterior case accommodating the electrode assembly and including a pair of long side curve portions spaced apart from each other, a pair of short side curve portions spaced apart from each other, and corner curve portions formed between the long side curve portions and the short side curve portions, wherein curvature radii of the long side curve portions are larger than those of the short side curve portions.

[0007] The curvature radii of the long side curve portions may be 1.1 to 3 times larger than those of the short side curve portions. Curvature radii of the corner curve portions may range between the curvature radii of the long side curve portions and the curvature radii of the short side curve portions. Depths of the short side curve portions may be larger than those of the long side curve portions. Depths of the corner curve portions may range between the depths of the short side curve portions and the depths of the long side curve portions. The laminate exterior case may include a planar first exterior case portion and a second exterior case portion covered by the first exterior case portion and having a recess formed to accommodate the electrode assembly. The second exterior case portion may include an extending region extending away from the first exterior case portion and an planar region connected to the extending region and parallel with the first exterior case portion, the long side curve portions and the short side curve portions may be formed at sides where the extending region and the planar region meet, and the corner curve portions may be formed at corners where the extending region and the planar region intersect each other. Thicknesses of the corner curve portions may be smaller than those of the long side curve portions or the short side curve portions.

[0008] According to the present invention, there is provided a secondary battery including an electrode assembly, and a laminate exterior case accommodating the electrode assembly and including a pair of long side curve portions spaced apart from each other, a pair of short side curve portions spaced apart from each other, and corner curve portions formed between the long side curve portions and the short side curve portions, wherein thicknesses of the corner curve portions are smaller than those of the long side curve portions or the short side curve portions.

[0009] According to the present invention, the thicknesses of the corner curve portions is 0.8 to 0.9 times larger than those of the long side curve portions or the short side curve portions. The laminate exterior case may have insulation layers formed on opposite surfaces of a metal layer, and thicknesses of metal layers of the corner curve portions may be smaller than those of the long side curve portions or the short side curve portions. Curvature radii of the long side curve portions may be larger than those of the short side curve portions. Curvature radii of the corner curve portions range between the curvature radii of the long side curve portions and the curvature radii of the short side curve portions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Features will become apparent to those of ordinary skill in the art by describing in detail exemplary embodiments with reference to the attached drawings in which:

FIGS. 1A and 1B illustrate an exploded perspective view and an assembling plan view of a secondary battery according to an exemplary embodiments;

FIGS. 2A and 2B illustrate a partially perspective

view and a front view of a secondary battery according to an exemplary embodiments;

FIGS. 3A, 3B and 3C are schematic sectional views illustrating a long side curve portion, a corner curve portion and a short side curve portion in a secondary battery according to an exemplary embodiments and FIG. 3D is a schematic sectional view virtually illustrating a long side curve portion, a corner curve portion and a short side curve portion; and

FIGS. 4A and 4B are sectional views illustrating thicknesses of a long side curve portion and a corner curve portion in a secondary battery according to an exemplary embodiments.

DETAILED DESCRIPTION

[0011] Example embodiments will now be described more fully hereinafter with reference to the accompanying drawings; however, they may be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete and will fully convey exemplary implementations to those skilled in the art.

[0012] In the drawings, the thickness of layers and regions are exaggerated for clarity. Like numbers refer to like elements throughout. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items. It will also be understood that when an element A is referred to as being "connected to" an element B, the element A can be directly connected to the element B or an intervening element C may be present and the element A and the element B are indirectly connected to each other.

[0013] Spatially relative terms, such as "beneath," "below," "lower," "above," "upper," and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements described as "below" or "beneath" other elements or features would then be oriented "on" or "above" the other elements or features. Thus, the exemplary term "below" can encompass both an orientation of above and below.

[0014] FIGS. 1A and 1B are an exploded perspective view and an assembling plan view of a secondary battery according to exemplary embodiments.

[0015] First, as illustrated in FIG. 1A, the secondary battery 100 according to exemplary embodiments includes an electrode assembly 110 and a laminate exterior case 120.

[0016] The electrode assembly 110 may include a first electrode 111, a second electrode 112 and a separator 113 interposed between the first electrode 111 and the second electrode 112. The electrode assembly 110 may be formed by winding a stacked structure of the first electrode 111, the separator 113 and the second electrode 112. While the electrode assembly 110 of a winding type or a jelly roll type is exemplified in the illustrated embodiment, a stack type electrode assembly may also be used in an alternative embodiment.

[0017] The first electrode 111 may function as a positive electrode and the second electrode 112 may function as a negative electrode, and vice versa. However, the following description will be made on the assumption that the first electrode 111 functions function as a positive electrode and the second electrode 112 function as a negative electrode.

[0018] The first electrode 111 includes a first electrode active material layer coated on both surfaces of a first electrode current collector made of a highly conductive metal thin plate, e.g., an aluminum foil or mesh, but not limited thereto. Here, a chalcogenide compound may be used as the first electrode active material, but not limited thereto. For example, a composite metal oxide, such as LiCoO2, LiMn2O4, LiNiO2, or LiNiMnO2, may be used as the first electrode active material. A first electrode tab 114 may be formed on a first electrode uncoated portion of the first electrode current collector, where the first electrode active material layer is not formed, but aspects are not limited thereto. That is to say, one end of the first electrode tab 114 may be electrically connected to the first electrode uncoated portion and the other end of the first electrode tab 114 may protrude to the outside. In addition, an insulation member 114a may be attached to the first electrode tab 114, thereby preventing the first electrode tab 114 from being shorted to the laminate exterior case 120.

[0019] The second electrode 112includes a second electrode active material layer coated on both surfaces of a second electrode current collector made of a conductive metal thin plate, e.g., a copper or nickel foil or mesh, but not limited thereto. Here, a carbon-based material, Si, Sn, tin oxide, tin alloy composite, transition metal oxide, lithium metal nitride or lithium metal oxide may be used as the second electrode active material, but not limited thereto. A second electrode tab 115 may be formed on a second electrode uncoated portion of the second electrode current collector, where the second electrode active material layer is not formed, but aspects are not limited thereto. That is to say, one end of the second electrode tab 115 may be electrically connected to the second electrode uncoated portion and the other end of the second electrode tab 115 may protrude to the outside. In addition, an insulation member 115a may be attached to the second electrode tab 115, thereby preventing the second electrode tab 115 from being shorted to the laminate exterior case 120.

[0020] The separator 113 is interposed between the first electrode 111 and the second electrode 112 and prevents an electric short between the first electrode 111 and the second electrode 112. The separator 113 may

include, but not limited to, one selected from the group consisting of polyethylene, polypropylene, and a porous copolymer of polyethylene and polypropylene. In order to prevent an electric short from occurring between the first electrode 111 and the second electrode 112, the separator 113 may be formed to have a larger width than the first electrode 111 and the second electrode 112.

[0021] In addition, the separator 113 may include, but not limited to, a solid electrolyte (e.g., an inorganic ceramic based electrolyte, such as perovskite-based, NASICON-based, LISICON-based, sulfide-based, Garnet-based or glass-based electrolyte, or a polymer based electrolyte). Here, a liquid electrolyte may not be used as the separator 113.

[0022] The laminate exterior case 120 accommodates the electrode assembly 110 and is formed by sealing the outer periphery of the electrode assembly 110. The laminate exterior case 120 includes a first exterior case portion 121 and a second exterior case portion 122 having one end connected to the first exterior case portion 121 and including a recess 123 having a predetermined depth so as to accommodate the electrode assembly 110.

[0023] In addition, edges 124 of the first and second exterior case portions 121 and 122, corresponding to the outer periphery of the electrode assembly 110, are thermally fused to each other, thereby allowing the electrode assembly 110 to be accommodated within the laminate exterior case 120 of a pouch type or a pocket type.

[0024] That is to say, the laminate exterior case 120 is configured to include the first and second exterior case portions 121 and 122 formed by bending the center of one side of a laminate exterior case shaped of a rectangular plate in a lengthwise direction. The second exterior case portion 122 has the recess 123 having a predetermined depth formed by pressing or drawing so as to accommodate the electrode assembly 110, and a sealing portion 124 is formed on the outer periphery of the recess 123 to be sealed with the first exterior case portion 121. The sealing portion 124 may be formed along one side where the first exterior case portion 121 and the second exterior case portion 122 integrally adjoin each other, and the other three sides of each of the first exterior case portion 121 and the second exterior case portion 122.

[0025] In addition, the second exterior case portion 122 includes four extending regions extending away from the first exterior case portion 121 and a planar region connected to the four extending regions and corresponding to a bottom of the recess 123. Here, relatively long regions among the four extending regions may be defined as long-side extending regions and relatively short regions among the four extending regions may be defined as short-side extending regions.

[0026] The first and second electrode tabs 114 and 115 of the electrode assembly 110 are drawn to the outside through fused regions of the first exterior case portion 121 and the second exterior case portion 122. Here, the insulation members 114a and 115b formed on the first and second electrode tabs 114 and 115 are also sealed with the sealing portion 124. That is to say, the insulation members 114a and 115b are formed at contact portions between the first and second electrode tabs 114 and 115 and the sealing portion 124 to prevent electrical shorts between the first and second electrode tabs 114 and 115 and the laminate exterior case 120.

[0027] The laminate exterior case 120 may be formed to have a multi-layered structure including a first insulation layer 120a, a metal layer 120b and a second insulation layer 120c, but not limited thereto. In addition, the laminate exterior case 120 may also include various adhesive layers or functional layers, but detailed descriptions thereof will not be given so as not to obscure the subject matter.

[0028] The first insulation layer 120a defines an internal surface of the laminate exterior case 120 and is made of an insulating and thermally adhesive material. In addition, the first insulation layer 120a is formed on one surface of the metal layer 120b and defines an internal surface of the laminate exterior case 120 facing the electrode assembly 110. The first insulation layer 120a may be made of casted polypropylene (CPP) or an equivalent thereof, which is not reactive with an electrolyte, but not limited thereto. If the electrode assembly 110 is accommodated in the recess 123 of the second exterior case portion 122 and is covered with the first exterior case portion 121, the first insulation layers 120a of the first and second exterior case portions 121 and 122 of the laminate exterior case 120 are brought into contact with each other. Therefore, if the sealing portion 124 is thermally fused, the first insulation layers 120a of the first and second exterior case portions 121 and 122 are adhered to each other. Thereby sealing the laminate exterior case 120.

[0029] The metal layer 120b is interposed between the first insulation layer 120a and the second insulation layer 120c, prevents external moisture and oxygen from penetrating into the laminate exterior case 120 and prevents an electrolyte filled in the laminate exterior case 120 from leaking to the outside. In addition, the metal layer 120b maintains mechanical strength of the laminate exterior case 120. In general, the metal layer 120b may be made of, but not limited to, aluminum, an aluminum alloy, iron or an iron alloy. The metal layer 120b may be elongated in the course of forming the recess 123. In particular, the and has a reduced thickness at its significantly elongated portion, resulting in cracks and lowering damp-proofing efficiency (that is, increasing moisture permeability). Therefore, it is quite important to control the thickness of the metal layer 120b elongated in the course of forming the recess 123.

[0030] The second insulation layer 120c defines an external surface of the laminate exterior case 120 and serves to absorb mechanical, chemical shocks with an external electric device. In addition, the second insulation layer 120c is formed on the other surface of the metal layer 120b and defines an external surface of the laminate exterior case 120. The second insulation layer 120c

may be made of nylon, polyethylene terephthalate (PET), polybuthylene terephthalate (PBT), polybuthylene naphthalate (PBN) or an equivalent thereof.

[0031] Meanwhile, as illustrated in FIG. 1B, in the secondary battery 100 according to exemplary embodiments, the second exterior case portion 122 of the laminate exterior case 120 may include a plurality of extending regions125, 126 and 127 extending away from the first exterior case portion 121 and a planar region 128 connected to the plurality of extending regions 125, 126 and 127 and substantially parallel with the first exterior case portion 121.

[0032] Here, the plurality of extending regions 125, 126 and 127 and the planar region 128 may define the recess 123 accommodating the electrode assembly 110. Specifically, two of the plurality of extending regions may be defined as the long-side extending regions 125 and the other two extending regions may be defined as the short-side extending regions 126, and corners between the long-side extending regions 125 and the short-side extending regions 126 may be defined as corner extending regions 127.

[0033] In addition, long side curve portions 125a having variable curvature radii are formed at sides, boundaries or regions where the planar regions 128 and the long-side extending regions 125 meet, and short side curve portions 126a having variable curvature radii are formed at sides, boundaries or regions where the planar regions 128 and the short-side extending regions 126 meet. Accordingly, the long side curve portion 125a is formed in a pair so as to face each other and the short side curve portion 126a is also formed in a pair so as to face each other.

[0034] Moreover, a corner curve portion 127a having variable curvature radii is formed at a corner or region where all of the planar region 128, the long-side extending region 125 and the short-side extending region 126 meet each other, that is, a region where the planar region 128 and the corner extending region 127 meet each other.

[0035] The corner curve portion 127a may include four corner curve portions. In addition, the corner curve portion 127a serves to connect the long side curve portion 125a to the short side curve portion 126a.

[0036] According to exemplary embodiments, the curvature radius of the long side curve portion 125a, the curvature radius of the short side curve portion 126a, the curvature radius of the corner curve portion 127a, the thickness of the long side curve portion 125a, the thickness of the short side curve portion 126a and the thickness of the corner curve portion 127a are adjusted and limited. Therefore, when compared with the prior art, the elongation of the corner curve portion 127a is reduced, thereby providing the secondary battery having reduced cracks (that is, improved damp-proofing performance) and improved outer appearance quality (that is, no creases or cracks), which will later be described in more detail.

[0037] FIGS. 2A and 2B are a partially perspective view and a front view of a secondary battery according to exemplary embodiments.

[0038] As illustrated in FIGS. 2A and 2B, in the secondary battery 100 according to exemplary embodiments, the second exterior case portion 122 of the laminate exterior case 120 may include a long-side extending region 125, a short-side extending region 126, a corner extending region 127, a planar region 128, a long side curve portion 125a, a short side curve portion 126a and a corner curve portion 127a.

[0039] A recess 123 having a predetermined depth is defined in the second exterior case portion 122 by the above-described constituents, thereby allowing the electrode assembly 110 to be accommodated in the recess 123.

[0040] In more detail, the long side curve portion 125a having variable curvature radii is formed at a side, boundary or region where the planar region 128 and the long-side extending region 125 meet, and the short side curve portion 126a having variable curvature radii is formed at a side, boundary or region where the short-side extending region 126 and the planar region 128 meet. In addition, the corner curve portion 127a having variable curvature radii is formed at boundaries or regions where the corner extending region 127, the long side curve portion 125a and the short side curve portion 126a meet.

[0041] According to exemplary embodiments, the long side curve portion 125a, the short side curve portion 126a and/or the corner curve portion 127a have substantially variable curvature radii. That is to say, the long side curve portion 125a, the short side curve portion 126a and the corner curve portion 127a have curvature radii varying according to locations or regions, rather than fixed curvature radii, thereby allowing the second exterior case portion 122 of the laminate exterior case 120 to be more securely attached to the electrode assembly 110, (that is, minimizing a gap or a space between the second exterior case portion 122 and the electrode assembly 110). Accordingly, movement or vibration of the electrode assembly 110 can be suppressed and the elongation during formation and occurrence of cracks can be reduced and the outer appearance quality can be improved, which will later be described in more detail.

[0042] Here, the term "variable curvature radii" means that curvature radii varying at every location or region, rather than being the same at every location or region. For example, the closer to the long-side extending region 125, the smaller the curvature radius of the long side curve portion 125a, and the closer to the planar region 128, the larger the curvature radius of the long side curve portion 125a. In addition, the closer to the short-side extending regions 126, the smaller the curvature radius of the short side curve portion 126a, and the closer to the planar region 128, the larger the curvature radius of the short side curve portion 126a. In addition, the closer to the corner extending regions 127, the smaller the curvature radius of the corner curve portion 127a, and the closer to the planar region 128, the larger the curvature radius

of the corner curve portion 127a.

[0043] As described above, according to the exemplary embodiments, the planar region 128, the long side curve portion 125a, the short side curve portion 126a and the corner curve portion 127a are effectively brought into close contact with the electrode assembly 110, thereby efficiently suppressing the electrode assembly 110 from moving or vibrating within the laminate exterior case 120. Accordingly, when the secondary battery is dropped, it is possible to efficiently preventing the electrode assembly 110 from increasing cracks and/or deteriorating the outer appearance due to movement or vibration of the electrode assembly 110.

[0044] FIGS. 3A, 3B and 3C are schematic sectional views illustrating a long side curve portion (125a), a corner curve portion (127a) and a short side curve portion (126a) in a secondary battery according to exemplary embodiments and FIG. 3D is a schematic sectional view virtually illustrating a long side curve portion (125a), a corner curve portion (127a) and a short side curve portion (126a).

[0045] For a better understanding, it should be noted that the first exterior case portion 121 and the second exterior case portion 122 of the laminate exterior case 120 are formed of a single layer, rather than multiple layers. In addition, it should be noted that the curvature radii of the long side curve portion 125a, the corner curve portion 127a and the short side curve portion 126a are inordinately exaggerated in FIG. 3D for a better understanding. As illustrated in FIGS. 3A to 3C and FIG. 3D, in the secondary battery 100 according to exemplary embodiments, the curvature radius of the long side curve portion 125a may be larger than that of the short side curve portion 126a. In addition, the curvature radius of the corner curve portion 127a may be smaller than that of the long side curve portion 125a and may be larger than that of the short side curve portion 126a. That is to say, magnitudes of the curvature radii of the long side curve portion 125a, the corner curve portion 127a and the short side curve portion 126a are in descending order.

[0046] In more detail, the curvature radius of the long side curve portion 125a may be approximately 1.1 to 3 times larger than that of the short side curve portion 126a. Here, if the curvature radius of the long side curve portion 125a is approximately 1.1 time smaller than that of the short side curve portion 126a, a gap or a space between the electrode assembly 110 and the long side curve portion 125a becomes relatively increased, so that the electrode assembly 110 may move or vibrate within the laminate exterior case 120 when the secondary battery 100 is dropped. In addition, if the curvature radius of the long side curve portion 125a is approximately 1.1 times larger than that of the short side curve portion 126a, the depth of the recess 123 is relatively small (that is, a sufficiently large space for accommodating the electrode assembly 110 is not provided), making difficult to accommodate the electrode assembly 110 within the laminate exterior case 120.

[0047] Particularly, as the described above, the inventor experimentally discovered that electrode assembly 110 was most securely positioned within the laminate exterior case 120 when the curvature radius of the long side curve portion 125a is approximately 1.1 to 3 times larger than that of the short side curve portion 126a and the curvature radius of the corner curve portion 127a range between the curvature radius of the long side curve portion 125a and the curvature radius of the short side curve portion 126a. That is to say, when the secondary battery 100 was dropped under the above-stated conditions, the electrode assembly 110 moved or vibrated within the laminate exterior case 120 to the least extent, a probability of cracks occurring to the long side curve portion 125a, the short side curve portion 126a and the corner curve portion 127a was smallest, and the quality of outer appearance was not deteriorated.

[0048] Here, since the respective curvature radii of the long side curve portion 125a, the corner curve portion 127a and the short side curve portion 126a are variable, they may be defined by, but not limited to, an average curvature radius, for example.

[0049] Meanwhile, exemplary embodiments may be described in terms of depth. The depth is a length from the first exterior case portion to a roughly central portion of each curve portion.. For example, the depth of the short side curve portion 126a is a length from the first exterior case portion 121 to a roughly central portion of the short side curve portion 126a and it may be larger than that of the long side curve portion 125a, i.e., a length from the first exterior case portion 121 to a roughly central portion of the long side curve portion 125a. In addition, the depth of the corner curve portion 127a is a length from the first exterior case portion 121 to the roughly central portion of the corner curve portion 127a and it may range between the depth of the long side curve portion 125a and the depth of the short side curve portion 126a. That is to say, the depths of the recess 123 with respect to the roughly central portion of each of the short side curve portion 126a, the corner curve portion 127a and the long side curve portion 125a are in descending order.

[0050] Under the above-stated conditions, the inventor discovered that most regions of the second exterior case portion 122 are effectively brought into close contact with the electrode assembly 110, thereby efficiently preventing the electrode assembly 110 from moving or vibrating within the laminate exterior case 120.

[0051] The reason of the forgoing is presumably because a region of the winding type electrode assembly 110 corresponding to the long side curve portion 125a of the laminate exterior case 120 is formed to be roughly round and a region corresponding to the short side curve portion 126a of the laminate exterior case 120 is formed roughly at right angle.

[0052] Additionally, the region of the winding type electrode assembly 110 corresponding to the long side curve portion 125a of the laminate exterior case 120 is mainly formed as an active material, which is relatively hard, and

the region corresponding to the short side curve portion 126a of the laminate exterior case 120 is mainly formed as an end of a separator, which is relatively soft. Therefore, when the laminate exterior case 120 is formed under the above-stated conditions of the curvature radii and/or depths, it is presumably possible to efficiently prevent the electrode assembly 110 from moving or vibrating within the recess 123.

[0053] FIGS. 4A and 4B are sectional views illustrating thicknesses of a long side curve portion (125a) and a corner curve portion (127a) in a secondary battery according to exemplary embodiments. Here, all features of the secondary battery, including thicknesses, may be substantially the same as those of the secondary battery illustrated in FIGS. 3A to 3D.

[0054] As illustrated in FIGS. 4A and 4B, in the secondary battery according to exemplary embodiments, a thickness of the corner curve portion 127a may be smaller than a thickness of the long side curve portion 125a and/or a thickness of the short side curve portion 126a.

[0055] As an example, the thickness of the corner curve portion 127a may be 0.8 to 0.9 times of the thickness of the long side curve portion 125a and/or the thickness of the short side curve portion 126a. If the thickness of the corner curve portion 127a is approximately 0.8 times smaller than the thickness of the long side curve portion 125a and/or the thickness of the short side curve portion 126a, the corner curve portion 127a is elongated to a relatively large extent during forming of the recess 123 or drawing. In this case, a probability of cracks occurring to the corner curve portion 127a is increased. In addition, if the thickness of the corner curve portion 127a is approximately 0.9 times larger than the thickness of the long side curve portion 125a and/or the thickness of the short side curve portion 126a, the corner curve portion 127a is elongated to a relatively small extent during forming of the recess 123 or drawing. In this case, the recess 123 having a sufficiently large depth for accommodating the electrode assembly 110 may not be formed.

[0056] As described above, the laminate exterior case 120 is configured such that a first insulation layer 120a is formed on one surface of a metal layer 120b and a second insulation layer 120c is formed on the other surface of the metal layer 120b. However, during forming of a recess 123 or drawing, the metal layer 120b may be elongated. Here, the first and second insulation layers 120a and 120c are more elongated than the metal layer 120b.

[0057] As an example, the metal layers 120b in the long side curve portion 125a and/or the short side curve portion 126a are maintained to have a thickness in the range of approximately 19 μm to 21 μm even after being elongated, while the metal layer 120b in the corner curve portion 127a is maintained to have a thickness in the range of approximately 16 μm to 18 μm after being elongated. If the thickness of the metal layer 120b in the corner curve portion 127a is smaller than the thickness in the range stated above, cracks are liable to occur due to external shocks or during forming, and the outer appearance may be deteriorated due to a low level of hardness. Therefore, according to exemplary embodiments, the curvature radius of the corner curve portion 127a is so limited as described above so as not to excessively reduce the thickness of the metal layer 120b of the corner curve portion 127a, as illustrated in FIGS. 3A to 3D.

[0058] However, if the long side curve portion 125a, the short side curve portion 126a and the corner curve portion 127a having the above-stated curvature radii are formed by punching or pressing, the thickness varying rate (elongation) of the metal layer 120b can be minimized by minimizing the stress concentration on the corner curve portion 127a, thereby suppressing cracks from occurring to the corner curve portion 127a and improving the quality of outer appearance of the corner curve portion 127a.

[0059] Meanwhile, according to exemplary embodiments, a width of the long side curve portion 125a (that is, a width crossing the long side curve portion 125a) may be larger than a width of the short side curve portion 126a (that is, a width crossing the short side curve portion 126a). Accordingly, a width of the long-side extending region 125 (that is, a width crossing the long-side extending region 125) may be smaller than a width of the short-side extending region 126 (that is, a width crossing the short-side extending region 126). Therefore, according to exemplary embodiments, a gap or a space between the long-side extending region 125 and the long side curve portion 125a of the second exterior case portion 122 and roughly round regions of the electrode assembly 110 corresponding thereto can be minimized. In addition, a gap or a space between the short-side extending region 126 and the short side curve portion 126a of the second exterior case portion 122 and roughly planar regions of the electrode assembly 110 corresponding thereto can be minimized.

[0060] Moreover, since the corner curve portion 127a is formed between the long side curve portion 125a and the short side curve portion 126a and the corner extending portion 127 is formed between the long-side extending region 125 and the short-side extending portion 126, the gaps or spaces of the electrode assembly 110 corresponding to the corner extending portion 127 and the corner curve portion 127a can be minimized.

[0061] By way of summation and review, exemplary embodiments provide a secondary battery, which can suppress cracks from occurring to corners by reducing corner elongation of a laminate exterior case and can improve the quality of outer appearance of the corners.

[0062] As described above, according to exemplary embodiments, the elongation of corner curve portions of the laminate exterior case is reduced, thereby suppressing cracks from occurring to corner curve portions and improving the quality of outer appearance of the corner curve portions. That is to say, according to exemplary embodiments, the long side curve portions are formed to have larger curvature radii than the short side curve

portions, and/or the corner curve portions are formed to have curvature radii between the long side curve portions and the short side curve portions, corner curve portions thereby suppressing cracks from occurring to corner curve portions and improving the quality of outer appearance of the corner curve portions. That is to say, according to exemplary embodiments, damp-proofing performance of the corner curve portions against external moisture can be improved and it is possible to suppress creases or cracks from occurring to the corner curve portions due to external shocks.

[0063] In addition, according to exemplary embodiments, the corner curve portions are formed to have smaller thicknesses than the long side curve portions and/or the short side curve portions. Specifically, the corner curve portions are formed to have thicknesses of 0.8 to 0.9 times larger than the long side curve portions and/or the short side curve portions, thereby suppressing cracks from occurring to corner curve portions (that is, improving damp-proofing performance) and improving the quality of outer appearance of the corner curve portions (that is, suppressing creases or cracks).

[0064] It is clear for a person skilled in the art that the disclosed embodiments can also be combined where possible, according to appended claims.

Claims

1. A secondary battery comprising:

an electrode assembly (110); and
a laminate exterior case (120) accommodating the electrode assembly (110) and including a pair of long side curve portions (125a) spaced apart from each other, a pair of short side curve portions (126a) spaced apart from each other, and corner curve portions (127a) formed between the long side curve portions (125a) and the short side curve portions (126a),
wherein curvature radii of the long side curve portions (125a) are larger than those of the short side curve portions (126a),
characterized in that curvature radii of the corner curve portions (127a) range between the curvature radii of the long side curve portions (125a) and the curvature radii of the short side curve portions (126a),
that thicknesses of the corner curve portions (127a) are smaller than those of the long side curve portions (125a) or the short side curve portions (126a), and
that the thicknesses of the corner curve portions (127a) are 0.8 to 0.9 times larger than those of the long side curve portions (125a) or the short side curve portions (126a).

2. The secondary battery of claim 1, wherein the curvature radii of the long side curve portions (125a) are 1.1 to 3 times larger than those of the short side curve portions (126a).

3. The secondary battery of claim 1 or 2 , wherein depths of the short side curve portions (126a) are larger than those of the long side curve portions (125a).

4. The secondary battery of one of the preceding claims, wherein depths of the corner curve portions (127a) range between the depths of the short side curve portions (126a) and the depths of the long side curve portions (125a).

5. The secondary battery of one of the preceding claims, wherein the laminate exterior case (120) includes a first exterior case portion (121), a second exterior case portion (122) covered by the first exterior case portion (121) and a recess (123) formed to accommodate the electrode assembly (110).

6. The secondary battery of claim 5, wherein the second exterior case portion (122) includes an extending region extending away from the first exterior case portion (121) and an planar region connected to the extending region and parallel with the first exterior case portion (121), the long side curve portions (125a) and the short side curve portions (126a) are formed at sides where the extending region and the planar region meet, and the corner curve portions (127a) are formed at corners where the extending region and the planar region intersect each other.

7. The secondary battery of claim 1, wherein the laminate exterior case (120) has insulation layers (120a, 120c) formed on opposite surfaces of a metal layer (120b), and thicknesses of metal layers (120b) of the corner curve portions (127a) are smaller than those of the long side curve portions (125a) or the short side curve portions (126a).

Patentansprüche

1. Eine Sekundärbatterie, aufweisend:

eine Elektrodenanordnung (110); und
ein Laminat-Außengehäuse (120), das die Elektrodenanordnung (110) aufnimmt und ein Paar Langseiten-Krümmungsabschnitte (125a), die voneinander beabstandet sind, ein Paar Kurzseiten-Krümmungsabschnitte (126a), die voneinander beabstandet sind, und Eck-Krümmungsabschnitte (127a), die zwischen den Langseiten-Krümmungsabschnitten (125a) und den Kurzseiten-Krümmungsabschnitten (126a) ausgebildet sind, aufweist,

wobei Krümmungsradien der Langseiten-Krümmungsabschnitte (125a) größer als die der Kurzseiten-Krümmungsabschnitte (126a) sind, **dadurch gekennzeichnet, dass** Krümmungsradien der Eck-Krümmungsabschnitte (127a) im Bereich zwischen den Krümmungsradien der Langseiten-Krümmungsabschnitte (125a) und den Krümmungsradien der Kurzseiten-Krümmungsabschnitte (126a) liegen,
dass Dicken der Eck-Krümmungsabschnitte (127a) kleiner als die der Langseiten-Krümmungsabschnitte (125a) oder der Kurzseiten-Krümmungsabschnitte (126a) sind, und
dass die Dicken der Eck-Krümmungsabschnitte (127a) 0,8 bis 0,9 mal größer als die der Langseiten-Krümmungsabschnitte (125a) oder der Kurzseiten-Krümmungsabschnitte (126a) sind.

2. Die Sekundärbatterie nach Anspruch 1, wobei die Krümmungsradien der Langseiten-Krümmungsabschnitte (125a) 1,1 bis 3 mal größer als die der Kurzseiten-Krümmungsabschnitte (126a) sind.

3. Die Sekundärbatterie nach Anspruch 1 oder 2, wobei Tiefen der Kurzseiten-Krümmungsabschnitte (126a) größer als die der Langseiten-Krümmungsabschnitte (125a) sind.

4. Die Sekundärbatterie nach einem der vorhergehenden Ansprüche, wobei Tiefen der Eck-Krümmungsabschnitte (127a) im Bereich zwischen den Tiefen der Kurzseiten-Krümmungsabschnitte (126a) und den Tiefen der Langseiten-Krümmungsabschnitte (125a) liegen.

5. Die Sekundärbatterie nach einem der vorhergehenden Ansprüche, wobei das Laminat-Außengehäuse (120) einen ersten Außengehäuseabschnitt (121), einen zweiten Außengehäuseabschnitt (122), der vom ersten Außengehäuseabschnitt (121) bedeckt wird, und eine Aussparung (123), die ausgebildet ist, um die Elektrodenanordnung (110) aufzunehmen, aufweist.

6. Die Sekundärbatterie nach Anspruch 5, wobei der zweite Außengehäuseabschnitt (122) einen Erstreckungsbereich, der sich vom ersten Außengehäuseabschnitt (121) weg erstreckt, und einen ebenen Bereich, der mit dem Erstreckungsbereich verbunden ist und parallel zum ersten Außengehäuseabschnitt (121) ist, aufweist, wobei die Langseiten-Krümmungsabschnitte (125a) und die Kurzseiten-Krümmungsabschnitte (126a) auf Seiten, an denen der Erstreckungsbereich und der ebene Bereich aufeinandertreffen, ausgebildet sind und die Eck-Krümmungsabschnitte (127a) an Ecken, an denen sich der Erstreckungsbereich und der ebene Bereich schneiden, ausgebildet sind.

7. Die Sekundärbatterie nach Anspruch 1, wobei das Laminat-Außengehäuse (120) Isolationsschichten (120a, 120c), die auf gegenüberliegenden Oberflächen einer Metallschicht (120b) ausgebildet sind, aufweist, und wobei Dicken der Metallschichten (120b) der Eck-Krümmungsabschnitte (127a) kleiner als die der Langseiten-Krümmungsabschnitte (125a) oder der Kurzseiten-Krümmungsabschnitte (126a) sind.

Revendications

1. Batterie rechargeable comprenant :

un ensemble d'électrodes (110) ; et
un boîtier extérieur stratifié (120) logeant l'ensemble d'électrodes (110) et comprenant une paire de parties incurvées latérales longues (125a) espacées l'une de l'autre, une paire de parties incurvées latérales courtes (126a) espacées l'une de l'autre, et des parties incurvées de coin (127a) formées entre les parties incurvées latérales longues (125a) et les parties incurvées latérales courtes (126a),
dans laquelle les rayons de courbure des parties incurvées latérales longues (125a) sont supérieurs à ceux des parties incurvées latérales courtes (126a),
caractérisée en ce que les rayons de courbure des parties incurvées de coin (127a) sont compris entre les rayons de courbure des parties incurvées latérales longues (125a) et les rayons de courbure des parties incurvées latérales courtes (126a),
en ce que les épaisseurs de parties incurvées de coin (127a) sont inférieures à celles des parties incurvées latérales longues (125a) ou des parties incurvées latérales courtes (126a), et
en ce que les épaisseurs des parties incurvées de coin (127a) sont de 0,8 à 0,9 fois supérieures à celles des parties incurvées latérales longues (125a) ou des parties incurvées latérales courtes (126a).

2. Batterie rechargeable selon la revendication 1, dans laquelle les rayons de courbure des parties incurvées latérales longues (125a) sont de 1,1 à 3 fois supérieures à ceux des parties incurvées latérales courtes (126a).

3. Batterie rechargeable selon la revendication 1 ou 2, dans laquelle les profondeurs des parties incurvées latérales courtes (126a) sont supérieures à celles des parties incurvées latérales longues (125a).

4. Batterie rechargeable selon l'une des revendications précédentes, dans laquelle les profondeurs des par-

ties incurvées de coin (127a) sont comprises entre les profondeurs des parties incurvées latérales courtes (126a) et les profondeurs des parties incurvées latérales longues (125a).

5. Batterie rechargeable selon l'une des revendications précédentes, dans laquelle le boîtier extérieur stratifié (120) comprend une première partie de boîtier extérieur (121), une seconde partie de boîtier extérieur (122) recouverte par la première partie de boîtier extérieur (121) et un évidement (123) formé pour loger l'ensemble d'électrodes (110).

6. Batterie rechargeable selon la revendication 5, dans laquelle la seconde partie de boîtier extérieur (122) comprend une région d'extension s'étendant à distance de la première partie de boîtier extérieur (121) et une région planaire raccordée à la région d'extension et parallèle à la première partie de boîtier extérieur (121), les parties incurvées latérales longues (125a) et les parties incurvées latérales courtes (126a) sont formées au niveau des côtés où la région d'extension et la région planaire se rencontrent, et les parties incurvées de coin (127a) sont formées au niveau des coins où la région d'extension et la région planaire se coupent.

7. Batterie rechargeable selon la revendication 1, dans laquelle le boîtier extérieur stratifié (120) a des couches isolantes (120a, 120c) formées sur les surfaces opposées d'une couche métallique (120b), et les épaisseurs des couches métalliques (120b) des parties incurvées de coin (127a) sont inférieures à celles des parties incurvées latérales longues (125a) ou des parties incurvées latérales courtes (126a).

FIG. 1A

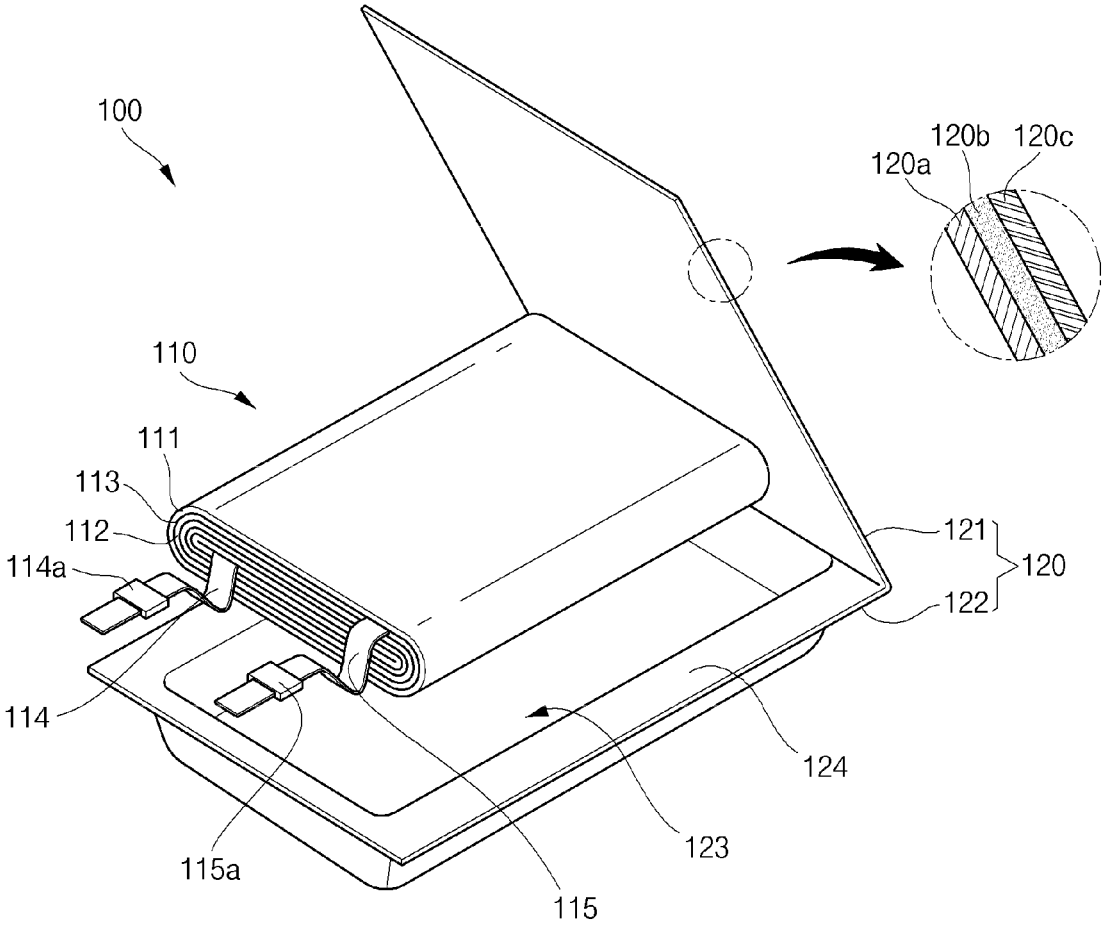

100
110
111
113
112
114a
114
115a
115
123
124
120b
120c
120a
121
120
122

FIG. 1B

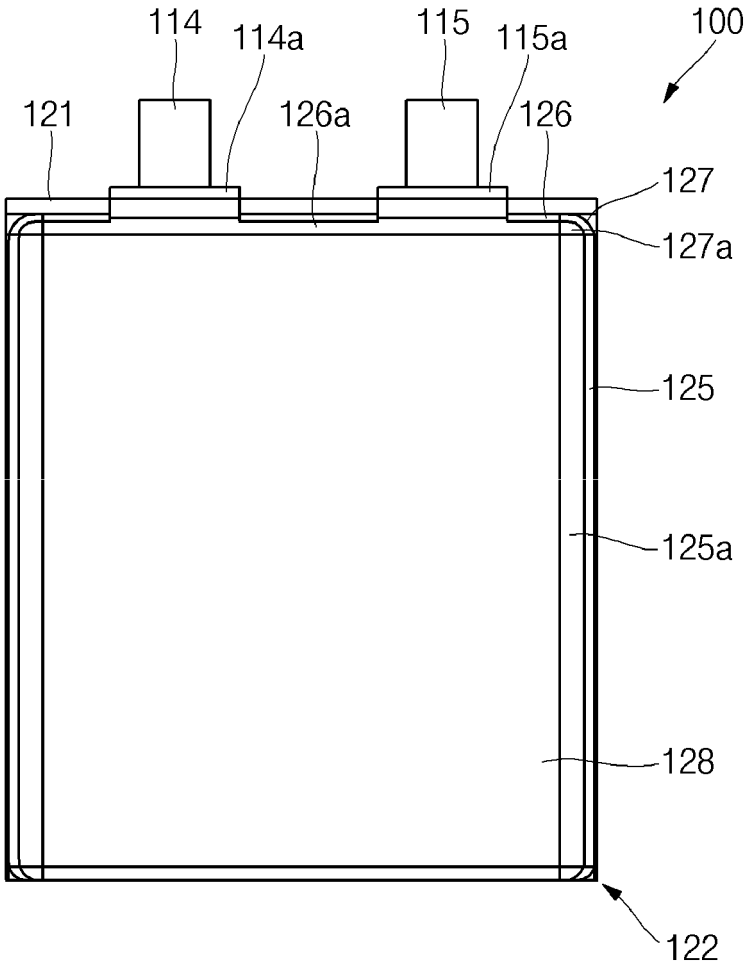


FIG. 2A

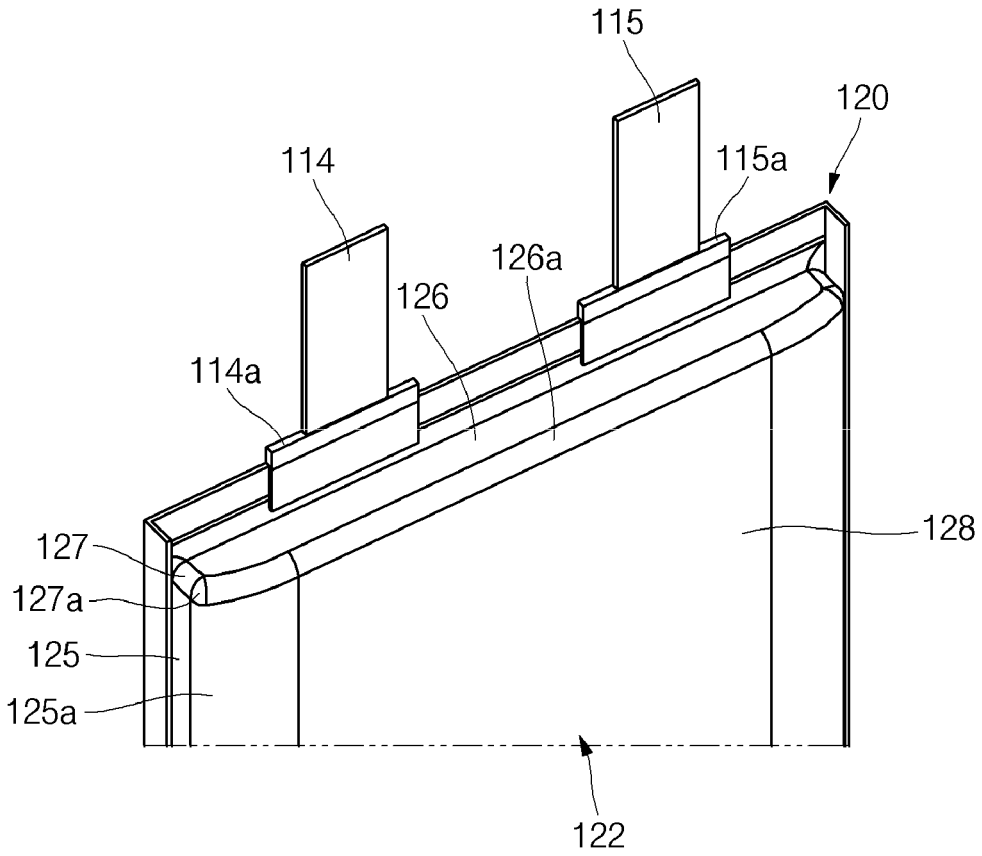

115
120
114
115a
126a
126
114a
128
127
127a
125
125a
122

FIG. 2B

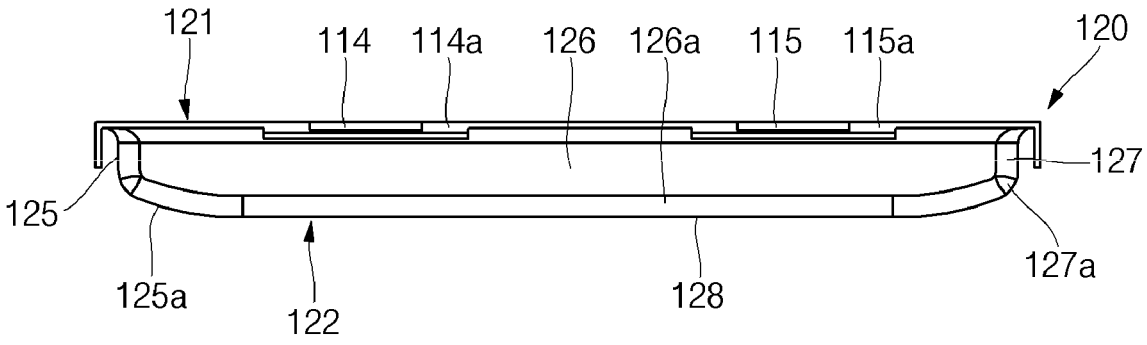

121
114
114a
126
126a
115
115a
120
127
125
125a
122
128
127a

FIG. 3A

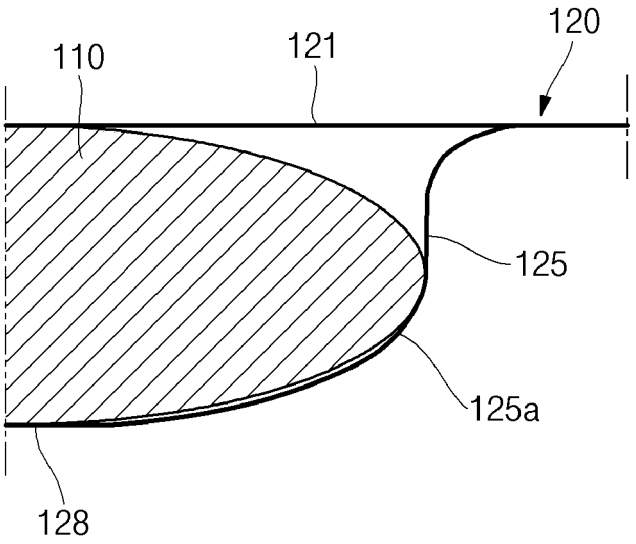


FIG. 3B

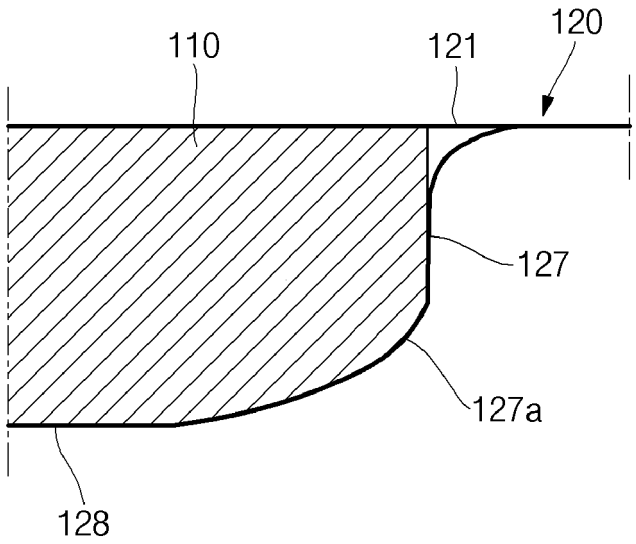


FIG. 3C

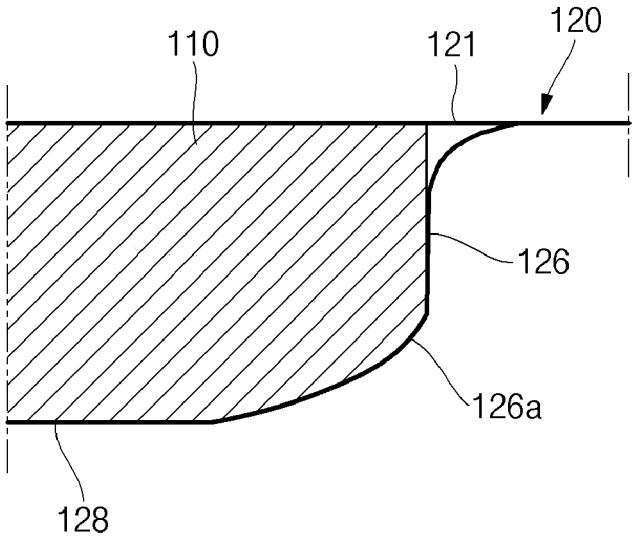

110
121
120
126
126a
128

FIG. 3D

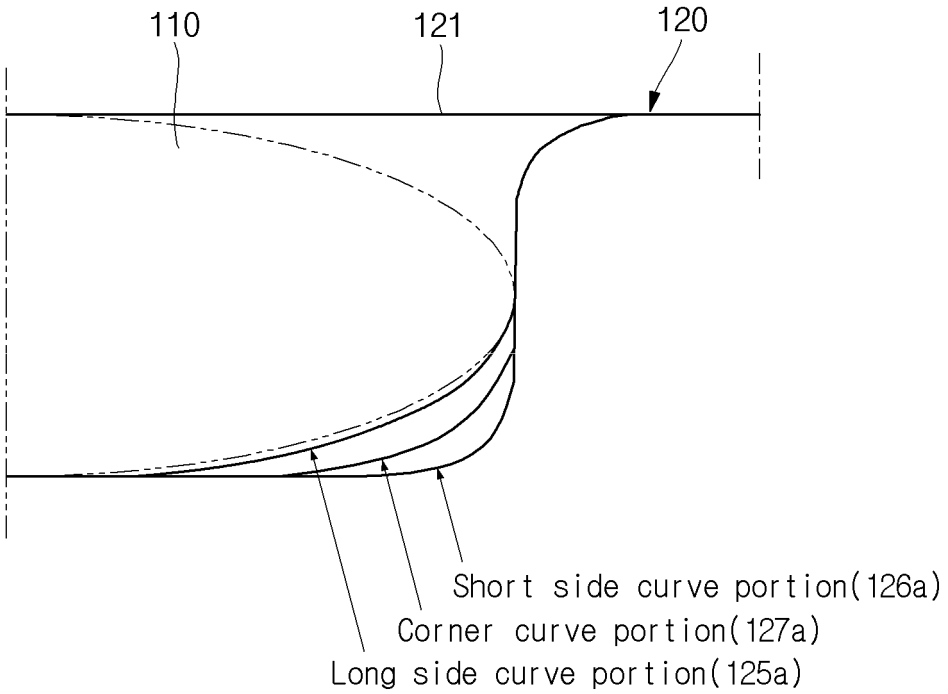

110
121
120
Short side curve portion(126a)
Corner curve portion(127a)
Long side curve portion(125a)

FIG. 4A

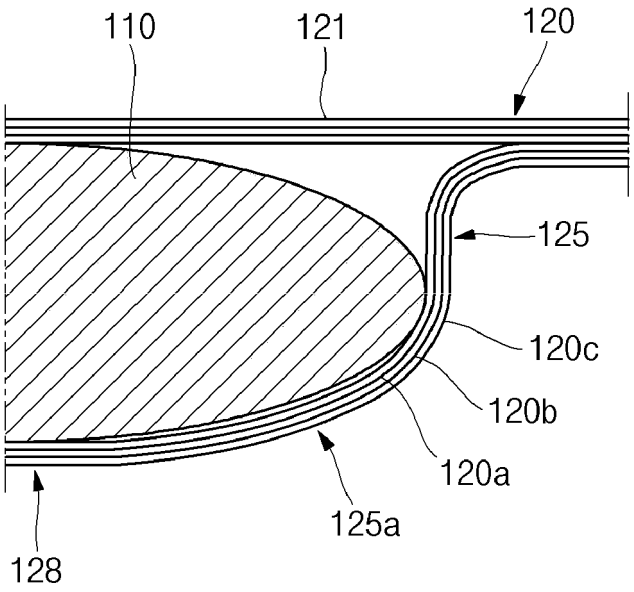
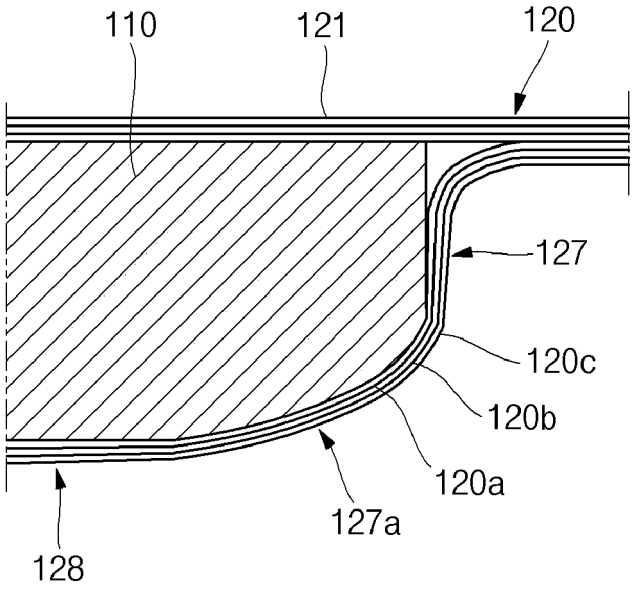

110
121
120
125
120c
120b
120a
125a
128

FIG. 4B


110
121
120
127
120c
120b
120a
127a
128

REFERENCES CITED IN THE DESCRIPTION

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